



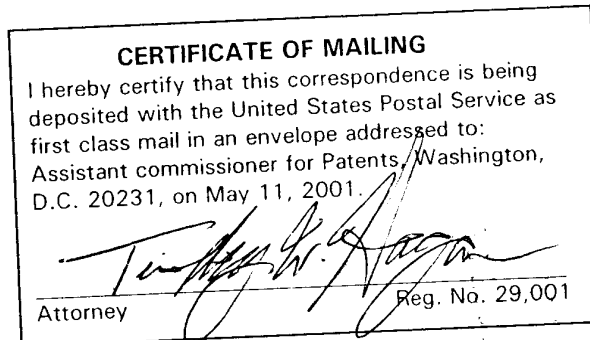
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application of

Applicant : Jigish D. Trivedi
Serial No. : 08/915,658
Filed : August 21, 1997
Title : LOW RESISTANCE METAL SILICIDE LOCAL INTERCONNECTS AND
METHOD OF MAKING
Docket : MIO 0024 PA
Examiner : G. Peralta
Art Unit : 2814

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:



APPLICANT'S REPLY BRIEF

This reply brief is being filed in response to the Examiner's Answer mailed March 28, 2001, and to respond to certain arguments raised therein. Pursuant to 37 CFR §1.193(b)(1), entry and consideration of this reply brief is requested. Also pursuant to the Rule, the Examiner is requested either to acknowledge receipt and entry of the reply brief or withdraw the final rejection and reopen prosecution to respond to the reply brief.

The Claims Do Not Stand or Fall Together

The Examiner asserted at page 2 of her Answer that "[t]he rejection of claims 31-40 stand or fall together because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof." However, applicant submits that the required statement was made, and reasons were given.

Quoting from page 3 of applicant's main Brief on Appeal,

The Examiner has made *two separate grounds of rejection* based on the prior art as outlined above: claims 31-34 as being unpatentable under 35 U.S.C. §102 over Okamoto

and claims 35-40 as being unpatentable under 35 U.S.C. §103 over Okamoto in view of Shepard. *Applicant will argue the patentability of claim 31 as representative of claims 31-34 because the issues of novelty and whether the Examiner has carried her burden are believed to be the same for dependent claims 32-34. Applicant will argue the patentability of claim 35 as representative of claims 35-40 because the issues of obviousness and whether the Examiner has carried her burden of establishing a prima facie case of obviousness are believed to be the same for claims 36-40 on appeal.* [Emphasis supplied.]

Thus, applicant stated that he was separately arguing the patentability of claims 31 and 35, and provided reasons in support, namely that there were two separate grounds of rejection based on different sections of the statute and requiring different burdens of proof on different issues.

Okamoto Does Not Anticipate Claim 31

Claim 31 recites a local interconnect whose composite structure comprises "[1] a first metal silicide, [2] a second metal silicide, and [3] an intermetallic compound comprising metal from said first metal silicide and metal from said second metal silicide." (Brackets added.) As described in applicant's specification, the composite structure 37 is formed by annealing a patterned tungsten silicide (WSi_x ; structure 34A) with a titanium metal layer 32. Thus, applicant starts with a metal layer and a metal silicide layer to produce a composite structure of two metal silicides and an intermetallic compound comprising the two metals.

Okamoto states in col. 5, lines 35-41, that a metallurgical reaction **may** take place between a titanium silicide film and a molybdenum silicide film and form a **ternary silicide film**. But, in none of Okamoto's disclosed processes is there described a composite structure comprising [1], [2], and [3] as claimed. Rather, the text at col. 5, and accompanying Figs. 4A-4D, describes a layered structure of a ternary silicide 30 and $MoSi_2$ (Fig. 4A), a layered structure of a ternary silicide 30 and $TiSi_2$ (Fig. 4B), a structure of only a ternary silicide 30 (Fig. 4C), and a ternary silicide structure 30 sandwiched between layers of $MoSi_2$ and $TiSi_2$ (Fig. 4D). Thus, nowhere does Okamoto teach the claimed invention, a composite structure of the three recited compounds.

Moreover, Okamoto does not mention expressly or inherently the formation of an **intermetallic compound** from two different metals in different metal silicide layers. Unlike applicant, Okamoto starts with two metal silicide layers and does not expressly or inherently disclose forming an intermetallic compound comprising two metals.

Applicant does not understand the Examiner to be asserting that Okamoto forms the compound Ti_xMo_y . Rather, the Examiner is understood to be asserting that $Ti_xMo_ySi_z$ is an intermetallic compound as one skilled in the art would understand that term. Applicant has already addressed the shortcomings of the definition provided by the Examiner from Merriam-Webster's Collegiate Dictionary. At least the portion of the definition which states that "intermetallic" can comprise "a metal and a nonmetal" is plainly incorrect. As the prefix "inter-" means "between" or "among," "intermetallic" has to mean between or among metals, not between or among a metal and a non-metal. The evidence proffered by applicant of art-recognized definitions of the disputed term supports applicant's position.

The newly-cited passages by the Examiner from the Kirk-Othmer Encyclopedia of Chemical Technology (vol. 3, p. 826) are inconsistent as well. Of the approximately 10-15 "beryllides" which are listed in Table 1 as "Beryllium Intermetallic Compounds," every single one of them comprise two metals. The mention of the compound $MoSi_2$ as an intermetallic compound is not proper usage of the term as silicon is understood not to be a metal.

For all of these reasons, Okamoto does not anticipate the claimed invention.

The Teachings of Okamoto and Shepard Are Not Combinable

Initially, as this rejection is clearly based on the Examiner's incorrect assertion that Okamoto teaches the formation of an intermetallic compound, the rejection fails for that reason. Moreover, one of ordinary skill in the art would not think to combine the teachings of Okamoto with those of Shepard because Shepard uses a completely different process to create a local interconnect having a germanium layer and a polysilicon conductive layer. Thus, the teachings of Okamoto would not be properly combinable because a completely different semiconductor

device is taught using different materials. Furthermore, no motivation or suggestion exist in either Shepard or Okamoto to combine their teachings.

The Examiner's assertion at page 5 of her Answer that the Shepard "local interconnect comprises a composite structure that includes a plurality of metal silicide layers" is not accurate. What Shepard teaches, for the FET embodiment of the invention (Fig. 3) is that the "local interconnect strap 72" is either polysilicon or a composite film "where a metal or metal silicide film is deposited over the polysilicon film to form a composite structure." Col. 4, lines 28-32. Thus, all that Shepard requires is a layer of polysilicon, and perhaps a layer of metal or metal silicide. In the other embodiment described by Shepard, a layer of germanium must also be deposited, with a layer of polysilicon then being deposited over the germanium layer. Okamoto, on the other hand, is specifically directed to solving, among others, the problem of diffusion of a conductive aluminum layer into an underlying silicon layer. See generally columns 1 and 2.

The Examiner, in a passage which suffers from either missing words or typographical errors, asserts on page 9 of the Answer that

The motivation to combines is the shows [sic] that it is well known and desirable in the art to [sic] characteristic of metal silicides of lower resistivities that can be an advantage for interconnect structures.

However, the Okamoto construction is complicated by the problem of diffusion of the aluminum conducting layer, requiring a second metal silicide layer (MoSi_2) protect a first metal silicide layer (TiSi_2) layer from being etched away, and a barrier layer (TiN) to prevent aluminum diffusion. As Shepard faces none of these problems, there is no motivation to completely change the local interconnect structure and composition of Shepard. The rejection fails for these additional reasons.

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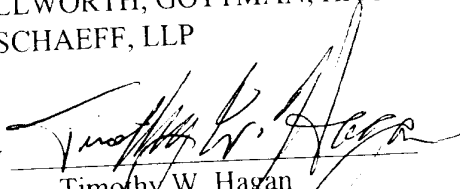
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Conclusion

For all of these reasons, Applicant submits that the rejections are not well taken and all rejections of claims 31-40 should be reversed in their entirety by this Board.

Respectfully submitted,
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By


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